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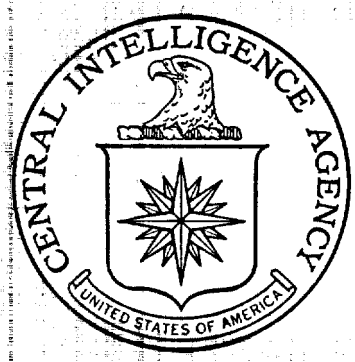
PROVISIONAL INTELLIGENCE REPORT

THE FIXED NITROGEN INDUSTRY IN POLAND



CIA/RR PR-66
28 July 1954

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PROVISIONAL INTELLIGENCE REPORT

THE FIXED NITROGEN INDUSTRY IN POLAND

CIA/RR PR-66

(ORR Project 22.157)

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S-E-C-R-E-T

THE FIXED NITROGEN INDUSTRY IN POLAND*

Summary

The fixed nitrogen industry in Poland is important to the peacetime economy of the country and would be an essential element of the industrial structure in time of war. In a wartime economy the production of fixed nitrogen would become a basic component of the munitions industry. Under peacetime conditions the fixed nitrogen industry is primarily concerned with providing agriculture with the necessary fertilizers and with producing industrial explosives.

It is estimated that up to 90 percent of the production of fixed nitrogen is currently being channeled to agriculture and that under normal conditions this pattern will continue, at least through 1955. Before World War II, Polish agriculture depended on natural organic materials (animal manure) for fertilizer. The loss of approximately two-thirds of the livestock numbers during World War II forced Poland to turn to the nitrogen industry for the necessary nitrogenous fertilizers. By 1954 the industry had expanded to more than twice its prewar size and had acquired a capacity almost a third as large as that of the fixed nitrogen industry of the USSR.

In 1953 the industry in Poland, operating at capacity, produced 124,000 metric tons** of nitrogen***. During 1954 the industry is being expanded to a capacity of 172,000 tons and in 1955 will be further expanded to a capacity of 236,000 tons. It is estimated that the industry will operate at capacity in 1954 and 1955.

The primary expansion is being made at a new plant at Kedzierzyn, which will come into production in 1954 and will reach its capacity of 120,000 tons in 1956. Two other major plants, at Moscice and Chorzow, are also scheduled for expansion during this period.

The industry is not vulnerable to economic warfare. Poland is self-sufficient in the raw materials needed in the fixed nitrogen

* The estimates and conclusions contained in this report represent the best judgment of the responsible analyst as of 15 July 1954.
** Throughout this report tonnages are given in metric tons.
*** All figures referring to plant capacity and production are in terms of nitrogen content unless otherwise indicated.

industry, and the technology of producing nitrogen compounds is well known.

A shift to a wartime basis in the fixed nitrogen industry of Poland would be indicated by increased production of concentrated nitric acid and ammonium nitrate, with a concurrent decreased production of fertilizers. There is no evidence to suggest that such a shift is being planned. There is evidence, however, of a continuing expansion in the fertilizer program, with a probable shift to the large-scale direct application of anhydrous ammonia. Such a shift would entail considerable investment and must be considered as still in an experimental stage.

I. Introduction.

The fixed nitrogen industry in Poland, as considered in this report, includes the following commodities:

1. Synthetic ammonia
2. Nitric acid
3. Nitrogen fertilizers
   a. Fertilizer from synthetic ammonia
   b. Byproduct ammonium sulfate
   c. Calcium cyanamide
4. Miscellaneous nitrogen compounds
   a. Anhydrous ammonia
   b. Ammonium chloride
   c. Sodium nitrate
5. Industrial fixed nitrogen

In peacetime the fixed nitrogen industry contributes mainly to the agricultural sector of the economy. The most significant product of the industry is synthetic ammonia, which is needed for the production of nitric acid, nitrogen fertilizers, and industrial explosives.

In wartime the industry provides essential strategic materials. The ammonium nitrate used in making fertilizer is also a major component of many explosives. In addition, synthetic ammonia and concentrated nitric acid are required in the manufacture of all other nonatomic military explosives, and concentrated nitric acid is utilized as an oxidizer in rocket and guided missile fuels.

II. History and Organization of the Industry.

Following World War I, there was a worldwide expansion of the fixed nitrogen industry resulting from the development of commercially feasible modifications of the Haber-Bosch process.* Three of the five Polish nitrogen plants that are in operation in 1954 were built between 1928 and 1933. 1/** Although the two largest plants at that time, at Moscice and at Chorzow, were heavily damaged during World War II and suffered further by dismantling after the war, 2/ they were again in operation by 1947. Their capacities are being expanded at the present time. 3/ The current status of these plants is considered in Appendix A.

The basic trend in the postwar organizational structure of Polish industry has been toward greater functional and geographic integration, aiming at simplification of the chain of supervisory responsibility and reduction of the number of organizational echelons. The most recent tendency has been to institute a three-echelon system: the ministry, the central administration, and the producing plant. The division of administrative functions in the three-echelon system is as follows:

1. Ministry: general supervisory functions, the regulation and organization of industry.

2. Central administration: general management, the coordination and control of branches of industry.

3. Producing plant: production and management of physical and financial resources.

* For a description of the technology employed in the production of fixed nitrogen compounds, see CIA/RR PR-49, The Fixed Nitrogen Industry in Czechoslovakia, 1 Mar 1954. S, US OFFICIALS ONLY.
** Footnote references in arabic numerals are to sources listed in Appendix D.

The law of 12 May 1950 on the reorganization of industry established the principle that in key industries the single plant is the basic organizational unit responsible for independent financial accounting, planned agreements on output, and direct contact with its sources of supply. This law also established an Economic Committee of the Council of Ministers responsible for the coordination of actual industrial output with the national economic plan.

Under a resolution of 30 December 1950, control over industry is divided among the following ministries: Heavy Industry, Light Industry, Agriculture and Foodstuffs Industry, Chemical Industry, Industrial Building, Urban Building, and Mining. 4/

The Ministry of the Chemical Industry has under its jurisdiction the following central administrations:

Inorganic Chemicals
Sulfuric Acid and Phosphorous Fertilizer
Synthetic Chemistry
Dyes and Dye Intermediates
Explosives
Paints and Lacquers
Technical Gases
Chemical Plant Construction
Rubber
Artificial Fibers
Pharmaceuticals
Paper
Sales 5/

The fixed nitrogen industry falls under the jurisdiction of the Central Administration for Inorganic Chemicals and consists of five plants:

Kedzierzyn	State Factory of Nitrogen Compounds 6/
Moscice	State Factory of Nitrogen Compounds 7/
Chorzow	State Factory of Nitrogen Compounds 8/
Wyry	Upper Silesia Nitrogen Works 9/
Knurow	Leasing Company of Polish State Mines, Inc. 10/

III. Supplies.

A. Production.

1. Synthetic Ammonia.

The production of synthetic ammonia in Poland was limited until 1948 by the capacity of the old established plants. A significant increase was made between 1948 and 1952 as the old plants were rebuilt and the plants at Chorzow and Moscice were expanded. 11/ Wyry and Knurow are relatively small installations, and it is believed that no marked expansion was carried out at either of these plants. In 1954, with the new plant at Kedzierzyn coming into production, an appreciable expansion will have been realized. This increase, however, will not be sufficient to meet the ambitious 1955 plan of 340,800 tons of nitrogen. 12/

Estimated production of synthetic ammonia in Poland for selected years from 1935 through 1955 is given in Table 1.*

No new synthetic ammonia plants are currently under construction, and the plans to build a plant at Gniewoszow have been abandoned. 13/

Production estimates for synthetic ammonia plants in 1954 and 1955 are given in Table 2.**

2. Nitric Acid.

Nitric acid is produced at Chorzow, Moscice, and Kedzierzyn. All nitric acid in Poland is produced by reacting ammonia with air in the presence of a platinum-rhodium (2 to 10 percent rhodium) wire-gauze catalyst. 14/

Table 3*** gives the estimated production of nitric acid for selected years from 1935 through 1955.

3. Nitrogen Fertilizers.

Several types of fertilizers containing nitrogen in varying degrees are produced in Poland. To provide a common denominator

* Table 1 follows on p. 6.
** Table 2 follows on p. 7.
*** Table 3 follows on p. 7

Table 1

Estimated Production of Synthetic Ammonia in Poland
Selected Years, 1935-55 a/

Metric Tons

Year	Production: Synthetic Ammonia	Production: Nitrogen Content	Probable Range of Production (Synthetic Ammonia) b/
1935	24,000	19,750	19,750 to 28,800
1936	30,700	25,290	24,560 to 36,840
1937	32,000	26,320	25,600 to 38,400
1938	37,500	30,900	30,000 to 45,000
1939-45	73,000 15/	60,000 c/	N.A.
1946	4,074 16/	3,360 c/	N.A.
1947	18,200	15,000	14,560 to 21,840
1948	41,400	34,000	33,120 to 49,680
1949	49,200	40,500	39,360 to 59,040
1950	56,000	46,000	44,800 to 67,200
1951	62,000	51,000	49,600 to 74,400
1952	65,500	54,000	52,400 to 78,600
1953	68,000	56,000	54,400 to 81,600
1954	133,500	110,000	106,800 to 160,200
1955	204,000	168,400	163,200 to 244,800

a. See Appendix B for methodology used in developing this table.
b. An arbitrary range of 20 percent was adopted.
c. Figure represents reported actual production.

Table 2

Estimated Production by Synthetic Ammonia Plants in Poland
1954 and 1955 a/

Metric Tons

Plant	Location	Production of Synthetic Ammonia b/ (Nitrogen Content) 1954	1955
State Factory of Nitrogen Compounds	Kedzierzyn	37,000	88,400
State Factory of Nitrogen Compounds	Moscice	30,000	33,000
State Factory of Nitrogen Compounds	Chorzow	20,000	22,000
Upper Silesia Nitrogen Works	Wyry	15,000	15,000
Leasing Company of Polish State Mines, Inc.	Knurow	8,000	10,000

a. See Appendix A for detailed plant studies.
b. See Appendix B for methodology used in deriving estimates.

Table 3

Estimated Production of Nitric Acid in Poland
Selected Years, 1935-55 a/*

Metric Tons

Year	Production b/	Probable Range of Production c/
1935	2,026	17/
1936	7,713	18/
1937	8,785	19/
1939-45	62,000	49,600 to 74,400

* Footnotes for Table 3 follow on p. 8.

Table 3

Estimated Production of Nitric Acid in Poland
Selected Years, 1935-55 a/
(Continued)

Metric Tons

Year	Production b/	Probable Range of Production c/
1947	1,737 (sic)	20/
1948	3,395 (sic)	21/
1949	39,750	31,750 to 47,650
1950	45,400	36,320 to 54,480
1951	50,000	40,000 to 60,000
1952	53,000	42,400 to 63,600
1953	55,100	43,980 to 66,020
1954	96,100	77,100 to 115,000
1955	165,000	132,000 to 198,000

a. See Appendix B for methodology used in developing this table.
b. Production figures are on the basis of 100 percent nitric acid.
c. An arbitrary range of 20 percent was adopted.

for purposes of comparison and to obtain a meaningful total production figure, all fertilizer production figures in this paper will be expressed in terms of nitrogen.

Polish nitrogen fertilizers can be broken down into three categories:

a. Nitrogen Fertilizers from Synthetic Ammonia.

The nitrogen in this category is supplied by nitric acid or ammonia, depending on the product. The four major products in this group are ammonium nitrate, ammonium sulfate, calcium ammonium nitrate (Saletrzak), and calcium nitrate.

b. Byproduct Ammonium Sulfate.

This fertilizer is produced from the ammonia liquor recovered at coke plants. It is therefore not a true product of the synthetic ammonia industry. It accounts for approximately 80 percent of the ammonium sulfate production of Poland.

c. Calcium Cyanamide.

Calcium cyanamide is produced in Poland only at Chorzow. 22/ Cyanamide in terms of nitrogen accounted for approximately 33 percent of the allotted nitrogen for fertilizer in 1953. This percentage will decrease in 1954 and 1955, however, since there are no plans to expand production of this commodity. 23/

Table 4* gives the estimated production of calcium cyanamide, calcium ammonium nitrate (Saletrzak), and ammonium sulfate for selected years from 1935 through 1955. Table 5** gives the estimated production of ammonium nitrate and calcium nitrate for selected years from 1935 through 1955.

4. Miscellaneous Nitrogen Compounds.

Poland also produces three other fixed nitrogen compounds, anhydrous ammonia, ammonium chloride, and sodium nitrate. These were reported as fertilizers in prewar data but are not generally considered fertilizers, and have not been reported as such in postwar figures. These industrial chemicals are essential to the industry of the country. The methodology adopted in this report makes it necessary to treat these compounds as a separate group. (See Appendix B.)

Anhydrous ammonia is used in the manufacture of dyes, in the mining and metallurgical industry, as a refrigerant, and in the manufacture of rayon. In addition, Poland is conducting experiments to determine the costs and advantages of applying this chemical directly to the soil as a fertilizer. 24/

Ammonium chloride, while similar in fertilization properties to ammonium sulfate, is not widely used as such because of

* Table 4 follows on p. 10.
** Table 5 follows on p. 11.

Table 4

Production of Specific Fertilizers in Poland
Selected Years, 1935-55 a/

Metric Tons

Year	Nitrogen Content		
	Calcium Cyanamide (21.0 Percent)	Calcium Ammonium Nitrate (Saletrzak) (20.5 Percent)	Ammonium Sulfate (20.6 Percent)
1935	6,500 25/	1,025 26/	12,500 27/
1936	6,100 28/	2,460 29/	12,600 30/
1937	14,300 31/	3,900 32/	13,440 33/
1938	16,800 34/	3,280 35/	14,500 36/
1939	N.A.	N.A.	N.A.
1939-45	N.A.	N.A.	N.A.
1946	20,800 37/	7,600 38/	7,160 b/
1947	25,400 39/	14,350 40/	8,783 41/
1948	33,200 42/	26,600 43/	10,300 44/
1949	34,600 45/	22,000 46/	10,800 b/
1950	35,000 b/	22,200 47/	14,200 b/
1951	36,000 48/	23,000 49/	15,000 b/
1952	36,100 b/	25,300 b/	16,100 b/
1953	37,000 b/	26,300 b/	16,900 b/
1954	38,000 b/	46,000 b/	17,500 b/
1955	38,000 b/	70,000 b/	20,000 b/

a. See Appendix B for methodology used in developing this table.
b. Estimated.

Table 5

Estimated Production of Ammonium Nitrate
and Calcium Nitrate in Poland
Selected Years, 1935-55 a/

Metric Tons

Year	Nitrogen Content	
	Ammonium Nitrate (32.5 Percent)	Calcium Nitrate (17.0 Percent)
1935	877 50/	7,000 51/
1936	975 52/	7,150 53/
1937	945 54/	9,700 55/
1938	1,410 56/	14,100 57/
1939	N.A.	N.A.
1939-45	N.A.	N.A.
1946	2,000 58/	N.A.
1947	5,630 59/	N.A.
1948	N.A.	N.A.
1949	6,180	6,450 60/
1950	6,500	9,000
1951	7,000	11,000
1952	7,500	14,000
1953	8,000	18,000
1954	10,000	37,500
1955	13,000	64,000 b/

a. It is impossible to isolate the amounts of ammonium nitrate and calcium nitrate utilized for fertilizer from that used for other purposes.
b. Planned.

the quantities of hydrochloric acid required in its manufacture. 61/ It is used in the manufacture of dyes, as an ingredient of dry cell batteries and various explosives, in tanning leather, and in the manufacture of soap. 62/

Sodium nitrate is used in the manufacture of glass, in pickling meat, as an ingredient in processing leather, and as a metallurgical flux. 63/

It is estimated that these miscellaneous nitrogen compounds will account for 4,000 tons of nitrogen in 1954 and 5,000 tons of nitrogen in 1955.

5. Industrial Fixed Nitrogen.

Industrial fixed nitrogen is required for the following:

a. The formation of cyanides and nitrides of metals.
b. Conditioning atmospheres for industrial processes.
c. Making nitrogen oxides.
d. Use as a filling agent in light bulbs (high candle power).
e. Preserving food products.
f. Synthesizing other nitrogen compounds. 64/

Requirements for industrial fixed nitrogen in 1954 are estimated at 19,000 tons (nitrogen content) and in 1955, 26,000 tons (nitrogen content). Table 6 gives the total estimated production and distribution of fixed nitrogen for selected years from 1935 through 1955.

Table 6

Total Estimated Production and Distribution of Fixed Nitrogen in Poland
Selected Years, 1935-55 a/*

Metric Tons Nitrogen

Year	Agriculture	Industry	Total
1935	27,000 65/	4,200 66/	31,200 67/
1936	32,000 68/	4,700 69/	36,700 70/
1937	42,000 71/	4,900 72/	46,900 73/
1938	50,000 74/	5,000 75/	55,000 76/
1939	N.A.	N.A.	78,000 b/
1939-45	N.A.	N.A.	N.A.
1946	N.A.	N.A.	N.A.
1947	N.A.	N.A.	N.A.

* Footnotes for Table 6 follow on p. 13.

Table 6

Total Estimated Production and Distribution of Fixed Nitrogen in Poland
Selected Years, 1935-55 a/
(Continued)

Metric Tons Nitrogen

Year	Agriculture	Industry	Total
1948	N.A.	N.A.	N.A.
1949	80,230	9,870	90,100
1950	89,000	10,400	99,400
1951	95,000	11,000	106,000
1952	102,000	13,000	115,000
1953	110,000	14,000	124,000
1954	153,000	19,000	172,000
1955	210,000 c/	26,000	236,000

a. Agriculture estimates for the years 1949-55 also include the production of anhydrous ammonia, ammonium chloride, and sodium nitrate. See Appendix B for methodology used in developing this table.
b. CIA estimate.
c. Estimated. Plan is 230,000 tons.

B. Stockpiling.

The most practical form in which nitrogen can be stockpiled is as a finished or semifinished product, such as filled munitions, explosives, and ammonium nitrate. Special care must be exercised in storing ammonium nitrate because it will absorb water from the air and "set" much like concrete. Attempts to restore such ammonium nitrate to a usable form involve the danger of explosion. 77/

Any attempt to stockpile nitric acid and ammonia as such, in the volume needed for war purposes, would require an almost prohibitive number of special pressure and noncorrosive containers.

Although there is no specific information concerning Polish stockpiling policy, certain facts, such as the continuing policies

of bartering coal with Austria for calcium ammonium nitrate (Saletrzak) and the admission that the Six Year Plan is lagging in respect to fixed nitrogen, 78/ indicate that there probably is no stockpiling.

This of course does not preclude the existence of normal industrial stocks of 1 to 3 months' supply of nitric acid, or the storage of fertilizers to meet seasonal demands.

C. Trade.

1. Exports.

Polish fixed nitrogen chemical trade is conducted by CIECH, "Centrala Importowa-Eksportowa Chemikalii i Aparatury Chemicznej" (General Import and Export Agency for Chemicals and Chemical Laboratory Equipment). 79/ This agency publishes periodical catalogues listing the chemical products available for export. Polish Foreign Trade, a bimonthly publication, also lists export items for sale. Table 7 shows the fixed nitrogen products listed as export items in these publications.

Table 7

Description of Fixed Nitrogen Products
Advertised as Available for Export by Poland 80/
1953

Product	Description
Sodium Nitrite	White crystalline powder, minimum purity, 98 percent.
Nitric Acid	Concentrated, minimum purity 97 percent.
Ammonium Chloride	Refined, is exported in the following grades: 1. Refined, minimum purity 99.5 percent, in the form of crystalline powder. 2. Refined, minimum purity 94 percent, in the form of crystalline powder. 3. 99.5 percent in snow white bars weighing one-half kilogram or 1 pound.

Table 7

Description of Fixed Nitrogen Products
Advertised as Available for Export by Poland 80/
1953
(Continued)

Product	Description
Aluminum Ammonium Sulfate	Technical grade, minimum purity 11.2 percent Al_2O_3.
Ammonium Bicarbonate	Minimum purity 99.7 percent; 21.5 percent NH_3.
Potassium Nitrate	Exported in three grades: 1. Refined, minimum purity 99.5 percent. 2. Technical grade, minimum purity 99 percent. 3. "Grade 3," minimum purity 97 percent.

The available information on Polish exports during the period 1950 to 1955 does not reveal an export business approaching the scale indicated by trade publications. Table 8* shows fixed nitrogen exports from Poland for the period 1950 through 1955, by country of destination and commodity. It is interesting to note that ammonium sulfate is both imported and exported.

2. Imports.

The most significant of the fixed nitrogen products being imported are calcium ammonium nitrate (Saletrzak) from Austria and ammonium sulfate from East Germany. The continuing importation of these commodities supports the view that the fixed nitrogen industry is not able to meet the consumption requirements of the country. It will be noted that there are no imports of synthetic ammonia.

Table 9** shows fixed nitrogen imports by Poland for the period 1950 through 1955, by country of origin and commodity.

* Table 8 follows on p. 16.
** Table 9 follows on p. 18.

Table 8

Exports of Fixed Nitrogen from Poland
by Destination and Commodity
1950-55 a/*

Metric Tons

Year and Destination	Nitrogen Content			
	Ammonium Nitrate	Ammonium Sulfate	Ammonium Chloride	Sodium Nitrate
1950				
Egypt	650 81/	1,570 82/	N.A.	N.A.
Sweden	N.A.	388 83/	N.A.	N.A.
Finland	N.A.	N.A.	N.A.	8.25 84/
Total	650	1,958	N.A.	8.25
1951				
China	N.A.	725 85/	N.A.	N.A.
Switzerland	N.A.	N.A.	14.5 86/	N.A.
Finland	N.A.	N.A.	N.A.	8.25 87/
Total	N.A.	725	14.5	8.25
1952				
Egypt	N.A.	263 88/	N.A.	N.A.
Total	N.A.	263	N.A.	N.A.
1953 a/				
China	N.A.	750 b/	N.A.	N.A.
Egypt	N.A.	275 b/	N.A.	N.A.
Total	N.A.	1,025	N.A.	N.A.

* Footnotes for Table 8 follow on p. 17.

Table 8

Exports of Fixed Nitrogen from Poland
by Destination and Commodity
1950-55 a/
(Continued)

Metric Tons

Year and Destination	Nitrogen Content			
	Ammonium Nitrate	Ammonium Sulfate	Ammonium Chloride	Sodium Nitrate
1954 a/				
China	N.A.	800 b/	N.A.	N.A.
Egypt	N.A.	300 b/	N.A.	N.A.
Total	N.A.	1,100	N.A.	N.A.
1955 a/				
China	N.A.	850 b/	N.A.	N.A.
Egypt	N.A.	350 b/	N.A.	N.A.
Total	N.A.	1,200	N.A.	N.A.

a. See Appendix B for methodology used in deriving these estimates.
b. Estimated.

Table 9

Imports of Fixed Nitrogen by Poland, by Origin and Commodity a/*
1950-55

Metric Tons

Year and Origin	Nitrogen Content				
	Calcium Nitrate	Calcium Ammonium Nitrate	Ammonium Sulfate	Ammonium Nitrate	Ammonium Chloride
1950					
Austria	N.A.	8,800 89/	N.A.	N.A.	N.A.
West Germany	N.A.	8,830 90/	N.A.	N.A.	N.A.
East Germany	N.A.	N.A.	N.A.	N.A.	N.A.
Belgium	N.A.	N.A.	N.A.	N.A.	N.A.
Total	N.A.	17,630	N.A.	N.A.	N.A.
1951					
Austria	N.A.	11,750 a/	N.A.	N.A.	N.A.
East Germany	N.A.	8,400 91/	8,400 92/	693 93/	N.A.
Czechoslovakia	N.A.	N.A.	N.A.	N.A.	45.3 94/
Total	N.A.	20,150	8,400	693	45.3
1952					
Austria	N.A.	12,600 a/	N.A.	N.A.	N.A.
West Germany	N.A.	N.A.	N.A.	N.A.	N.A.
East Germany	N.A.	N.A.	3,740 95/	7,410 96/	N.A.
United Kingdom	N.A.	N.A.	N.A.	N.A.	N.A.
Total	N.A.	12,600	3,740	7,410	N.A.

* Footnotes for Table 9 follow on p. 19.

Table 9

Imports of Fixed Nitrogen by Poland, by Origin and Commodity a/
1950-55
(Continued)

Metric Tons

Year and Origin	Nitrogen Content				
	Calcium Nitrate	Calcium Ammonium Nitrate	Ammonium Sulfate	Ammonium Nitrate	Ammonium Chloride
1953					
East Germany	850 97/	N.A.	9,850 98/	N.A.	N.A.
Total	850	N.A.	9,850	N.A.	N.A.
1954 b/					
Austria	N.A.	10,000 c/	N.A.	N.A.	N.A.
East Germany	N.A.	N.A.	9,000 c/	8,000 c/	N.A.
Total	N.A.	10,000	9,000	8,000	N.A.
1955 b/					
Austria	N.A.	10,000 c/	N.A.	N.A.	N.A.
East Germany	N.A.	N.A.	9,000 c/	8,000 c/	N.A.
Total	N.A.	10,000	9,000	8,000	N.A.

a. CIA estimate.
b. See Appendix B for methodology used in deriving this estimate.
c. Estimated.

3. Containers.

The chemical industry normally requires many diversified types of containers for efficient packing and packaging. Although

there is a shortage of aluminum tank cars, other containers are to be found in adequate amounts. Table 10 lists the types of containers for fixed nitrogen exports, which are advertised in available Polish trade publications. 99/

Table 10

Containers for Fixed Nitrogen Exports in Poland

Product	Container
Sodium Nitrite	Wooden or iron barrels, 150 kilograms net.
Nitric Acid	Aluminum containers, drum to tank car size.
Potassium Nitrate	Wooden barrels, 150 to 250 kilograms net, sheet-iron drums, 75 kilograms net.
Ammonium Chloride	Crystalline powder in wooden barrels, bars in wooden cases, 25 to 50 kilograms net.
Aluminum Ammonium Sulfate	Wooden barrels, 100 kilograms net.
Ammonium Bicarbonate	Paper-lined iron drums, 50 kilograms net.

IV. Consumption.

A. Synthetic Ammonia.

Synthetic ammonia in Poland is largely consumed directly in the production of nitric acid and fertilizers. The remainder is consumed by the chemical, metallurgical, and refrigeration industries. 100/

Based on the calculated input requirements for fertilizer and nitric acid, a general consumption pattern for synthetic ammonia in 1954 has been developed. Table 11* shows the estimated consumption of synthetic ammonia as nitrogen in Poland in 1954.

B. Nitric Acid.

The consumption pattern for nitric acid in Poland is based on fertilizer input requirements for 1954 and a study of US and Soviet consumption patterns. 101/ Table 12** shows the estimated consumption of nitric acid in Poland in 1954.

* Table 11 follows on p. 21.
** Table 12 follows on p. 21.

Table 11

Estimated Consumption of Synthetic Ammonia as Nitrogen in Poland a/
1954

Use	Consumption (Metric Tons Nitrogen Content)	Percent of Total
Nitrogen Fertilizers b/	83,390	75.5
Nitric Acid	23,735	21.6
Other	2,885	2.9

a. See Appendix B for methodology used in developing this table.
b. Because of insufficient data, all ammonium nitrate production has been included as fertilizer.

Table 12

Estimated Consumption of Nitric Acid in Poland a/
1954

Use	Consumption b/ (Metric Tons)	Percent of Total
Nitrogen Fertilizers	48,100	50
Explosives	19,100	20
Other c/	28,800	30

a. See Appendix B for methodology used in developing this table.
b. Consumption figures are on the basis of 100 percent acid.
c. Other uses include the manufacture of chemicals, dyes, and lacquers.

C. Nitrogen Fertilizers.

It is naturally assumed that all of the available fertilizer nitrogen will be consumed as fertilizer. Ammonium nitrate can be diverted to the production of explosives on short notice, however. It is estimated that 153,000 tons of nitrogen will be consumed as a constituent of fertilizer during 1954-55.

Table 13 shows consumption of nitrogen fertilizers in Poland during selected years.

Table 13

Consumption of Nitrogen Fertilizers in Poland
1937-38, 1945-50, and 1954-55

Metric Tons

Year	Consumption (Nitrogen Content)
Prewar a/	
1937-1938	29,400 102/
Postwar b/	
1945-1946	38,700 103/
1946-1947	50,800 104/
1947-1948	63,000 105/
1948-1949	70,800 106/
1949-1950	93,500 107/
1954-1955	153,000 (estimated)

a. 1937 boundaries.
b. Present boundaries..

The average Polish farmer is still not completely educated in the use of chemical fertilizers. This is illustrated by the fact that in the past farmers have used nitrogen extensively for root crops rather than grain crops, 108/ although, since nitrogen is essential to above-ground foliage, it could be used more advantageously for grain crops. 109/ Thus, as more fertilizer becomes available and its use

more widespread, an educational program will have to be instituted in order to achieve maximum exploitation of it.

D. Miscellaneous Nitrogen Compounds.

It is estimated that 4,000 tons of nitrogen in the form of anhydrous ammonium, sodium nitrate, and ammonium chloride will be consumed in Poland in 1954. These commodities will be used by the refrigeration, synthetic fiber, dye, leather, and explosives industries.

E. Industrial Fixed Nitrogen.

It is estimated that 19,000 tons of nitrogen will be consumed by Polish industry in 1954. This nitrogen will be used in the synthesis of dyes and lacquers, in tanning leather, as a metallurgical flux, in preserving foodstuffs, in the formation of metal nitrides and cyanides, and in the synthesis of other nitrogen compounds required by the industry.

F. All Forms of Nitrogen Compounds.

It is estimated that of the 172,000 tons of nitrogen available in 1954, 153,000 tons (89 percent) will be consumed as various fertilizers, and 19,000 tons (11 percent) will be consumed in various forms by industry.

V. Input Requirements.

A. Synthetic Ammonia.

Power requirements for the production of synthetic ammonia vary greatly according to the process used. Of a total estimated production of 133,500 tons of synthetic ammonia during 1954, it is estimated that about 7.2 percent, or 9,700 tons, will be produced from hydrogen obtained from coke oven gas; about 86.0 percent, or 114,800 tons, from hydrogen obtained from coke water gas; and 6.8 percent, or 9,100 tons, from hydrogen obtained by electrolysis.

The electrical energy required to produce 1 ton of synthetic ammonia by the three different processes is as follows 110/:

Coke Oven Gas Hydrogen	2,200 Kilowatt-Hours
Coke Water Gas Hydrogen	1,400 Kilowatt-Hours
Electrolytic Hydrogen	13,300 Kilowatt-Hours

Consumption coefficients for the production of 1 ton of synthetic ammonia, which are similar for all three processes, and are based on the experience of one US producer, are estimated as follows:

Nitrogen	720	to	800	Cubic Meters
Hydrogen	2,000	to	2,400	Cubic Meters
Iron Catalyst	135	to	150	Grams
Water	100	to	400	Cubic Meters
Steam (Process)	1	to	2	Metric Tons
Coal (for Steam and Power)	2	to	4	Metric Tons

Calculated from these coefficients, the total quantitative input requirements for the manufacture of 133,500 tons of synthetic ammonia in Poland during 1954 are given in Table 14.

Table 14

Input Requirements for the Manufacture of Synthetic Ammonia in Poland 1954

Input	Unit	Requirement		
Nitrogen	Million Cubic Meters	96	to	106.8
Hydrogen	Million Cubic Meters	267	to	320
Iron Catalyst	Metric Tons	18	to	20
Water	Million Cubic Meters	13.35	to	53.40
Steam (Process)	Metric Tons	133,500	to	267,000
Coal (for Steam and Power)	Metric Tons	267,000	to	534,000
Electric Energy	Million Kilowatt-Hours	302.85		

B. Nitric Acid.

Raw material and power requirements for the production of nitric acid are similar in all installations. Large variations do occur, however, in the quantities of steam and cooling water required. In the absence of Polish input data, Soviet data has been used.

The average consumption coefficients for the manufacture of 1 ton of nitric acid are as follows 111/:

Synthetic Ammonia	290	to	300	Kilograms
Platinum Catalyst	0.10	to	0.13	Grams
Water (for Cooling)	80	to	145	Cubic Meters
Steam	145	to	360	Kilograms
Electric Energy	210	to	300	Kilowatt-Hours

Calculated from these coefficients, the total quantitative input requirements for the manufacture of 96,000 tons of 100 percent nitric acid in Poland during 1954 are given in Table 15.

Table 15

Input Requirements for the Manufacture of Nitric Acid in Poland 1954

Input	Unit	Requirement		
Synthetic Ammonia	Metric Tons	27,850	to	28,800
Platinum Catalyst	Kilograms	9.6	to	12.4
Water (for Cooling)	Million Cubic Meters	7.68	to	13.9
Steam	Metric Tons	13,900	to	34,600
Electric Energy	Million Kilowatt-Hours	20.2	to	28.8

C. Nitrogen Fertilizers.

Input requirements will be calculated for calcium cyanamide, calcium ammonium nitrate (Saletrzak), ammonium nitrate, and calcium nitrate. These fertilizers represent more than 85 percent of the nitrogen fertilizer produced in Poland during 1954.

1. Calcium Cyanamide.

The consumption coefficients for the manufacture of 1 ton of calcium cyanamide are as follows 112/:

Calcium Carbide	650	to	750	Kilograms
Nitrogen	160	to	300	Cubic Meters a/
Electric Energy	80	to	90	Kilowatt-Hours

a. Estimated.

Calculated from these coefficients, the total quantitative input requirements for the manufacture of 180,000 tons of calcium cyanamide in Poland during 1954 are given in Table 16.

Table 16

Input Requirements for the Manufacture of Calcium Cyanamide in Poland 1954

Input	Unit	Requirement
Calcium Carbide	Metric Tons	117,000 to 135,000
Nitrogen	Million Cubic Meters	28.8 to 54.0
Electric Energy	Million Kilowatt-Hours	14.4 to 16.2

2. Ammonium Nitrate.

In the absence of Polish input data, Soviet data has been adopted. The average consumption coefficients for the production of 1 ton of ammonium nitrate are as follows 113/:

Synthetic Ammonia	0.217	to	0.220	Metric Tons
Nitric Acid (100 Percent)	0.785	to	0.795	Metric Tons
Steam	0.4	to	1.0	Metric Tons
Water	20	to	40	Cubic Meters
Electric Energy	15	to	30	Kilowatt-Hours

Calculated from these coefficients, the total quantitative input requirements for the production of 30,750 tons of ammonium nitrate in Poland during 1954 are presented in Table 17.*

3. Calcium Ammonium Nitrate (Saletrzak).

Since no Polish input data has been found, and since the product is not made in the USSR, German input data has been adopted.

* Table 17 follows on p. 27.

Table 17

Input Requirements for the Manufacture
of Ammonium Nitrate in Poland
1954

Input	Unit	Requirement
Synthetic Ammonia	Metric Tons	6,670 to 6,750
Nitric Acid (100 Percent)	Metric Tons	24,100 to 24,400
Steam	Metric Tons	12,300 to 30,750
Water	Thousand Cubic Meters	615 to 1,330
Electric Energy	Thousand Kilowatt-Hours	461 to 922.5

The average consumption coefficients for the production of 1 ton of Saletrzak on a nitrogen basis are as follows 114/:

Synthetic Ammonia (as Nitrogen)	0.5115 Metric Tons
Nitric Acid (100 Percent)	0.5115 Metric Tons
Calcium Carbonate (Limestone)	1.9400 Metric Tons
Kieselgur (Inert Filler)	0.0500 Metric Tons
Water	0.1000 Cubic Meters

Calculated from these coefficients, the total quantitative input requirements for the production of 224,000 tons (46,000 tons nitrogen) of Saletrzak in Poland during 1954 are given in Table 18.

Table 18

Input Requirements for the Manufacture
of Calcium Ammonium Nitrate in Poland a/*
1954

Input	Unit	Requirement
Synthetic Ammonia	Metric Tons	28,800
Nitric Acid (100 Percent)	Metric Tons	23,700

a. Footnote for Table 18 follows on p. 28.

Table 18

Input Requirements for the Manufacture of Calcium Ammonium Nitrate in Poland a/ 1954 (Continued)

Input	Unit	Requirement
Calcium Carbonate (Limestone)	Metric Tons	89,300
Kieselgur (Inert Filler)	Metric Tons	2,580
Water	Cubic Meters	4,600

a. Saletrzak.

4. Calcium Nitrate.

Calcium nitrate is not produced in the USSR, East Germany, or the US. 115/ It has therefore been necessary to estimate the input factors for this commodity. Estimated consumption coefficients for the production of one ton of calcium nitrate are as follows:

Synthetic Ammonia	0.255 Metric Tons
Calcium Carbonate (Limestone)	0.68 Metric Tons

Calculated from these coefficients, the total quantitative input requirements for the production of 220,500 tons of calcium nitrate in Poland during 1954 are given in Table 19.

Table 19

Input Requirements for the Manufacture of Calcium Nitrate in Poland 1954

Input	Unit	Requirement
Synthetic Ammonia	Metric Tons	56,400
Calcium Carbonate (Limestone)	Metric Tons	150,000

VI. Capabilities, Vulnerabilities, and Intentions.

A. Capabilities.

The fixed nitrogen industry is able to offer support both to strategic industries and to agriculture. During 1954, Poland will produce an estimated 133,500 tons of synthetic ammonia and an estimated 96,000 tons of 100-percent nitric acid. In 1955 the estimated production of these two commodities will be 204,000 tons of synthetic ammonia and 165,000 tons of 100-percent nitric acid. This production could be made available to the explosives industry in the event of war.

Expansion of the fixed nitrogen industry will be accomplished by expanding all existing plant facilities -- except at Kedzierzyn, which will not reach capacity until approximately 1956 -- and will necessarily be of a limited nature. 116/

B. Vulnerabilities.

Poland is self-sufficient in the raw materials needed by the nitrogen industry, except for special materials that may be required from the West.

The chemistry and engineering of "fixing" nitrogen is common knowledge and no vulnerability, present or potential, exists in this area.

C. Intentions.

A shift of the fixed nitrogen industry to a wartime basis would be heralded by increased production of explosives, especially concentrated nitric acid and ammonium nitrate, and lowered production of fertilizers. There is no evidence to conclude that such a shift is being planned. On the contrary, there is evidence of a continuing planned expansion of the fertilizer program, which is currently lagging. 117/

This continuing expansion may take the form of large-scale direct application of anhydrous ammonia. 118/ The adoption of such a course would require an investment of at least 40 million zlotys or 10 million dollars. It is estimated that 100 to 150 tank cars would be needed to carry the product from the factory to the railroad

stations in the farm area. Each railroad station in the area would require a 100-ton cistern or tank which would be filled twice yearly with 75 tons of anhydrous ammonia. It has been calculated that 280 cisterns would be required for each 700 farms to be serviced. Each farm would require fifteen to twenty 200-liter iron drums to move the anhydrous ammonia from the station to the farm. At the start of the operation the cisterns would all have to be equipped with pumps, piping, and other auxiliary equipment. The cost is broken down by the Polish government as follows 119/:

	Million Zlotys
Station Cisterns	30
Tank Cars	8
Miscellaneous	2
(Drums, Pumps, and Piping)	
Total	40

In view of the large expenditure involved, this plan must be considered still in an experimental stage. 120/

APPENDIX A

FIXED NITROGEN PLANTS IN POLAND

1. State Factory of Nitrogen Compounds.

a. Location.

Kedzierzyn, Poland.

b. Coordinates.

50°21'N - 18°12'E.

c. Products. 121/

Synthetic Ammonia
Granular Nitrogenous Fertilizers
Liquid Nitrogenous Fertilizers
Organic Nitrogen Compounds.

d. Annual Production.

The plant will go into production in 1954, and it is estimated that the annual production will be approximately 42,000 tons of nitrogen. The ultimate capacity, which it is estimated will be reached in 1956 or 1957, will be 120,000 tons of nitrogen. 122/

e. Process.

No information available.

f. Comments.

The plant was scheduled to go into operation in 1953, but difficulties have delayed its activation. 123/

2. State Factory of Nitrogen Compounds.

a. Location.

Moscice (near Tarnow).

b. Coordinates.

50°01'N - 20°56'E.

c. Products.

Synthetic Ammonia
Calcium-ammonium-nitrate (Saletrzak)
Calcium Nitrate
Ammonium Nitrate
Sodium Nitrate
Ammonium Sulfate
Nitric Acid.

d. Annual Production (Metric Tons).

Synthetic Ammonia.

1950 28,800 124/
1954 36,400 (Estimated)
1955 40,000 (Estimated).

Other Commodities.

No information available.

e. Process.

The ammonia is synthesized by the Fauser process, and the hydrogen is derived from coke water gas. 125/

It is assumed that nitric acid is produced by the oxidation and absorption of the resultant oxides in water.

Various fertilizers are produced by standard neutralization processes.

f. Comments.

Production and capacity data are too ambiguous to permit a firm presentation of annual production and capacity.

The Moscice plant was heavily damaged during World War II, but since then it has been reconstructed and considerably expanded. 126/

3. State Factory of Nitrogen Compounds.

a. Location.

Chorzow, Poland.

b. Coordinates.

50°18'N - 18°58'E.

c. Products. 127/

Synthetic Ammonia
Calcium Cyanamide
Nitric Acid
Ammonium Chloride
Ammonium Nitrate
Potassium Nitrate.

d. Annual Production (Metric Tons).

Synthetic Ammonia.

1950 10,000 128/
1954 24,200 (Estimated)
1955 26,700 (Estimated)

Calcium Cyanamide (As Nitrogen).

1938 16,800 129/
1947 25,400 130/
1949 34,600 131/
1951 36,100 (Estimated)
1954 36,100 (Estimated)
1955 36,100 (Estimated)

Other Commodities.

No information available.

e. Process.

The ammonia is synthesized by the NEC process, and the hydrogen is derived from coke water gas. 132/

f. Comments.

Production and capacity data are too ambiguous to permit a firm presentation of annual production and capacity.

This is the only plant in Poland producing calcium cyanamide. 133/ This plant was damaged less than Moscice in World War II and since that time has been rebuilt and expanded. 134/

4. Upper Silesia Nitrogen Works.

a. Location.

Wyry, Poland.

b. Coordinates.

50°08'N - 18°55'E.

c. Products.

Synthetic Ammonia.

d. Annual Production (Metric Tons).

Synthetic Ammonia.

1950	Wyry I	8,700	135/
	Wyry II	7,200	136/
1954	(Combined)	15,000	(Estimated).
1955	(Combined)	15,000	(Estimated).

e. Process.

This plant is a combination of two small plants referred to as Wyry I and Wyry II. Wyry I synthesizes ammonia by the NEC process, with the hydrogen derived from electrolysis and coke water gas. Wyry II utilizes the Fauser process and derives hydrogen from electrolysis and coke water gas. 137/

5. Leasing Company of Polish State Mines, Inc.

a. Location.

Knurow, Poland.

b. Coordinates.

50°13'N - 18°40'E.

c. Products.

Synthetic Ammonia.

d. Annual Production (Metric Tons).

Synthetic Ammonia.

1950	8,000	138/
1954	8,000	(Estimated)
1955	10,000	(Estimated)

e. Process.

The synthesis of ammonia is carried out by the air liquid process, and the hydrogen is derived from coke-oven gas. 139/

f. Comments.

This plant has received very little notice in Polish publications.

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APPENDIX B

METHODOLOGY

A. General.

The type of information available has made it necessary to treat the subject of this report on an over-all industry basis rather than on an individual plant study basis. The only fixed nitrogen production data available for the postwar years is that on production for agriculture; no information is available on production for industry. Data on production for both agriculture and industry are available for 1935-38. The method used in this report has been to calculate the nitrogen production for industry in 1935-38 as a percent of production for agriculture in those years, and then apply that percent to the production for agriculture in each of the years under consideration. The resulting figure is the estimated production for industry during that year. This figure added to the production for agriculture gives the estimated total fixed nitrogen production for the year.

B. Production.

1. Synthetic Ammonia, Table 1 and Table 2.

Although the production of synthetic ammonia is not announced, the production of fertilizers is announced. Production figures on synthetic ammonia are therefore based on the requirements of the fertilizer and nitric acid industries.

The estimates of production at Kedzierzyn for 1954 and 1955 are based on the following assumptions:

(a) Kedzierzyn will have a ultimate capacity of 120,000 tons of nitrogen per year. 140/

(b) The chemical plant was not in production in 1953. 141/

(c) The plant will come into production in stages, in the manner which is usual in the chemical industry.

Since there has been no publicity on expansion, and since photographs of the plant show none, it has been assumed that there has been no marked expansion at the Wyry combine.

The Knurow plant has not been mentioned in publicity dealing with expansion of the chemical industry. Some expansion has been credited to it, however, because the plant probably has been expanded in conjunction with the coal industry.

The Chorzow and Moscice plants have been rebuilt and expanded since the end of World War II. 142/ The 1954 and 1955 synthetic ammonia not accounted for by Kedzierzyn, Wyry, and Knurow (see Appendix B for methodology) has been credited to Chorzow and Moscice. It has been assumed that the increase in production at the two plants has been approximately the same.

2. Nitric Acid, Table 3.

Nitric acid estimates are based on the requirements of the industries consuming nitric acid.

3. Specific Fertilizers, Table 4 and Table 5.

The reported figures on annual production of calcium cyanamide are believed to be correct. The estimates for 1950 to 1955 are based on the fact that no production expansion of this product is planned. 143/ The slight estimated increase will result from more efficient operations. 144/

Calcium ammonium nitrate (Saletrzak) production has been reported through 1951. Estimates for 1953 to 1955 are a combination of the projections of past production plus the increase resulting from increased capacity.

Ammonium sulfate production was reported through 1948. Estimates for 1949 to 1950 are projections of past production plus the increase resulting from increased capacity.

Ammonium nitrate production was reported through 1947. Estimates for 1948 through 1955 are projections of past production plus the increase resulting from increased capacity.

Calcium nitrate production for 1949 was reported as 6,450 tons of nitrogen, 145/ and 1955 plan production was given as 10 times 1949 production. 146/

4. Fixed Nitrogen, Table 6.

Estimates of nitrogen production for agriculture are based on the sum of the nitrogen content of the fertilizers, including all ammonium and calcium nitrate, anhydrous ammonia, ammonium chloride, and sodium nitrate. In prewar years, this contributed between 87 and 91 percent of the total production. 147/ These latter four compounds have not been reported as fertilizers in postwar figures, and it is not believed that all the calcium and ammonium nitrate is to be used for fertilizer. For the sake of estimating, however, production of these compounds has been lumped, and this sum is considered to be 87 percent of total production. Industrial production is considered 11 percent of the total. The total is the sum of agricultural nitrogen plus industrial nitrogen.

C. Trade.

1. Fixed Nitrogen Exports, Table 8.

It has been assumed that exports will remain approximately the same as in 1951. Polish Foreign Trade lists several products available for export (see Table 7*), but there is no evidence of actual exports.

2. Fixed Nitrogen Imports, Table 9.

It has been assumed that imports will remain approximately the same as in 1951. Although production has increased, it probably will not reach plan level.

D. Consumption.

1. Synthetic Ammonia, Table 11.

The estimated consumption pattern for synthetic ammonia is based on the amount of synthetic ammonia needed for the production of fertilizer and nitric acid.

* Above, p. 14.

2. Nitric Acid, Table 12.

The estimated consumption pattern for nitric acid is based on the amount of nitric acid required for the production of nitrogen fertilizer, and on a study of Soviet and US use patterns.

E. Inputs, Calcium Nitrate, Table 19.

The coefficients for the production of 1 ton of calcium nitrate were calculated by acceptable stoichiometric methods.

APPENDIX C

GAPS IN INTELLIGENCE

The approximate fixed nitrogen capacity of Moscice and Chorzow in the immediate postwar period is known. Recent data on production and capacity are needed for these plants.

Polish official statistics on the production of nitric acid and synthetic ammonia on an aggregate basis are needed.

Information is needed on trade which distinguishes between commodities actually originating or terminating in Poland and commodities being handled by Poland in transshipment to other countries.

Approved For Release 1999/09/02 : CIA-RDP79-01093A000500170001-5

APPENDIX D

SOURCES AND EVALUATION OF SOURCES

1. Evaluation of Sources.

The following reports provided valuable, reliable, and comparatively detailed information concerning the pre-World War II fixed nitrogen industry in Poland.

UNRRA, Survey of Poland, 1944.

Polish Ministry of Information, Polish Statistical Handbooks, Warsaw, 1934-41.

The following material proved a valuable source of information on the postwar Polish fixed nitrogen industry.

Nowe Drogi, Warsaw.

Chemik, Warsaw.

2. Sources.

Evaluations, following the classification entry and designated "Eval.," have the following significance:

Source of Information	Information
Doc. - Documentary	1 - Confirmed by other sources
A - Completely reliable	2 - Probably true
B - Usually reliable	3 - Possibly true
C - Fairly reliable	4 - Doubtful
D - Not usually reliable	5 - Probably false
E - Not reliable	6 - Cannot be judged
F - Cannot be judged	

"Documentary" refers to original documents of foreign governments and organizations; copies or translations of such documents by a staff officer; or information extracted from such documents by a staff officer, all of which may carry the field evaluation "Documentary."

Evaluations not otherwise designated are those appearing on the cited document; those designated "RR" are by the author of this report. No "RR" evaluation is given when the author agrees with the evaluation on the cited document.

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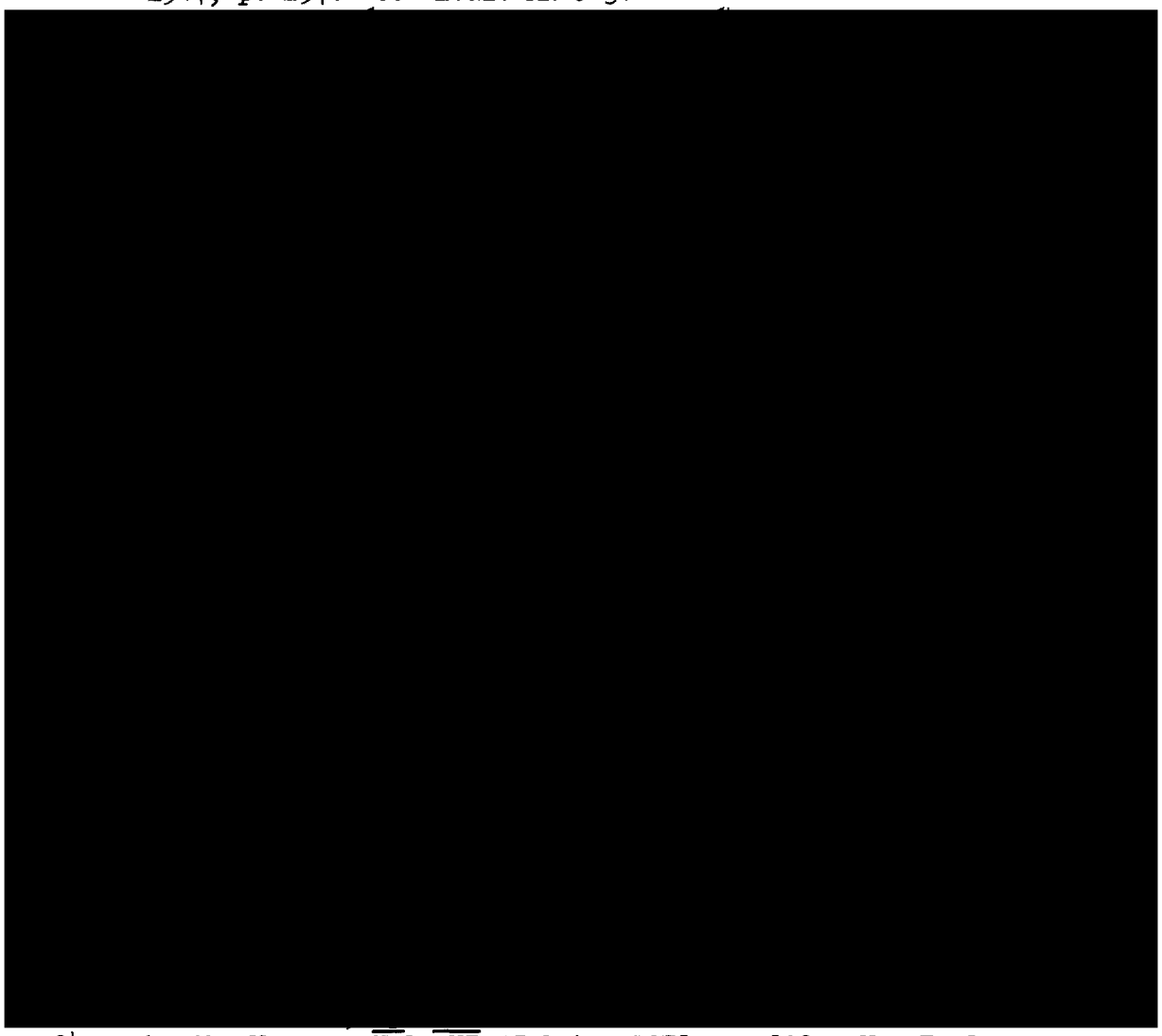

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